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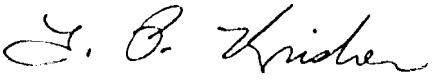
Dear Sirs:

In his letter on page 13 of the March 1993 issue, Robert Yaes raised the question of whether the existence of the cosmic microwave background (CMB), now observed so precisely with COBE, is compatible with the principle of relativity: "The laws by which the states of physical systems undergo change are not affected, whether these changes of state be referred to the one or the other of two systems of coordinates in uniform translatory motion."[1] Although I do not claim to provide an "expert" response to this question, as desired by Yaes, it is my understanding that the principle of relativity is not necessarily violated by the mere existence of a universal reference frame. The laws of physics can still be invariant under some transformation of coordinates. This transformation is not specified by the principle of relativity itself, although we have discovered so far that Nature respects Lorentz invariance (principle of the constancy of the velocity of light). What is really at issue here is whether an observer can perform purely 10CU1 measurements to reveal his state of motion with respect to a universal reference frame. If there existed some *interaction* which violates Lorentz invariance, then velocity–dependent effects could become locally apparent to a moving observer. It is an open question as to 1) whether such an interaction exists, and 2) what defines the true rest-frame respected by this interaction. It has become common-place in tests of special and general relativity to assume that this rest-frame is defined by the CMB, but this need not be the case.

Nevertheless, our knowledge of the existence of the CMB (unknown to Einstein) compels us to perform new tests of relativity which could reveal a local dependence upon our apparent motion defined by the dipole anisotropy. Recently a group of us at JPL have devised a new test of relativity involving atomic frequency standards and fiber optic instrumentation developed by the NASA Deep Space Network.[2-3] In the experiment, an atomic frequency standard is used to modulate a laser carrier signal which is propagated along an optical fiber directly to another atomic frequency standard several kilometers away. Unlike the Michelson–Morley experiment, the signal is propagated directly from one point in space to another. A violation of relativity would be apparent as a variation in tile phase-delay of the signal as the orientation of the system varies from the rotation of the Earth. It is possible to achieve a high degree of

precision with this test, provided that adequate funding can be obtained for necessary refinements.

Yours sincerely,



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## References:

1. A. Einstein, Ann. Physik 17, 891 (1905); translated by W. Perrett and G. B. Jeffery in *The Principle of Relativity* (Dover, New York, 1952).

2. T. P. Krisher *et* al., Phys. Rev. D 42, 731 (1990),

3. C. M. Will, Phys. Rev. D 45, 403 (1992),